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Specifications

1. Title of the Invention: Method of joining pipe units

2. Claims:

1. A method of joining pipe units, characterized in that, in a method in which a plurality of fiber-reinforced plastic pipe units are joined in a vertical direction by the bell-and-spigot method by means of an adhesive, the spigot part of one pipe unit is inserted into the bell part of the other pipe unit, after which an anti-corrosion layer is placed so that it covers the part where the lower end of the spigot part contacts the bottom of the bell; after this, an adhesive is injected between the spigot part and the bell part.

3. Detailed Explanation of Invention:

Field of Use in Industry

This invention concerns a method of joining synthetic resin pipe units with large opening diameters; in particular, it concerns a bell-and-spigot joining method.

Prior Art

Up to now, since smoke is exhausted from chimneys at a high temperature (150–200°C), it was hardly thought possible that the concrete or iron material would be corroded. However, in order to prevent pollution, it has become necessary in recent years to remove SO_x and NO_x, so that exhaust desulfurizing devices have been installed. In the case of wet methods for removing SO_x, etc., the exhaust gas outlet temperatures of these exhaust desulfurizing devices have been lowered to 60–70°C, and since it is difficult to remove the aforementioned SO_x and NO_x completely, water drops condense and adhere to the inner surfaces of smoke pathways or chimneys and become strongly acidic. Therefore, a tendency is seen for conventional concrete or iron, etc., to be corroded.

As a countermeasure against this corrosion, corrosion-resistant fiber-reinforced plastic (abbreviated below as "FRP") pipes can be inserted into already existing chimneys, but there is a tendency towards employing FRP pipe insertion methods from the point of view of reliability (strength and safety, etc.) and the work time. Furthermore, the method of making the chimney itself of FRP pipe or making various kinds of ducts from FRP pipe is coming into use.

As methods for joining FRP, there are the taper joining method, the butt joining method, the flange joining method, the conical joint method, the bell-and-spigot joining method, the bell mouth taper joining method, etc. However, as a method of joining pipes with large opening diameters, the bell (socket) and spigot (insert) joining method is the most suitable, and this method is being employed. Especially when FRP pipes are inserted into already existing chimneys, the flange joining method is unsuitable, because the gap between the pipe ad the chimney must be made as small as possible, and there are problems with the workability and joint strength in joining methods other than the bell-and-spigot method. Therefore, the bell-and-spigot method is ordinarily used as a method for joining large-diameter FRP pipes.

Figs. 1 to 3 are cross-sectional abbreviated drawings showing the conventional bell-and-spigot joining method; Fig. 1 shows the state before joining and Figs. 2 and 3 the state after joining. The symbol 1 indicates the bell part, 1′ the bottom of the bell, 2 the main pipe unit bodies, 3 the spigot part, 5 the lower end of the spigot part, 4 (in Figs. 2 and 3) the adhesive, and 6 (Fig. 3) the inner surface laminating part.

In the conventional method, the outer surface of the spigot part 3 of one pipe unit and the inner surface of the bell part 1 of the other pipe unit are worked by sanding or blasting, after which a resin putty for adhesion (referred to below as a "resin putty") is applied to the outer surface of the spigot part or the inner surface of the bell part and the spigot part is inserted into the bell part. However, even if the insertion clearance between the spigot and bell parts is 1 mm or more, the applied resin putty is pushed out or the applied resin putty becomes non-uniform and thus the resin putty does not completely enter the joint. Therefore, in many cases, only about 10–15% of the resin putty acts effectively, compared to the case in which the resin putty would completely enter the joint.

Therefore, not only is gas leakage produced from the pipe unit joint, but in many cases the cut surfaces of the glass fibers, etc., in the FRP are exposed in part of the lower end 5 of the spigot part. Therefore, there is a tendency for corrosion to occur from this part. In order to prevent this drawback, as shown in Fig. 3, after the pipe units are joined as described above, a laminating part 6 is formed from FRP on the inner surface of the pipe joint part so that it covers the contacting parts of the lower end 5 of the spigot part and the bottom of the bell 1'. In this case, it is desirable, of course, to perform a sanding or blasting operation beforehand on the inner surface of the spigot and the inner surface of the lower part of the bell part in order to make it easier to form the inner surface laminating part 6 with the FRP.

Purpose of the Invention

This invention is a method of joining a plurality of pipe units by the bell-and-spigot method; it provides a method by which the joint parts can be more completely adhered, according to the designed area, than with the conventional method, and the joining operation can be performed more efficiently.

Constitution of the Invention

This invention is a method of joining pipe units which is characterized by the fact that, in a method in which a plurality of fiber-reinforced plastic pipe units are joined in a vertical direction by the bell-and-spigot method by means of an adhesive, the spigot part of one pipe unit is inserted into the bell part of the other pipe unit, after which an anti-corrosion layer is placed so that it covers the part where the lower end of the spigot part contacts the bottom of the bell; after this, an adhesive is injected between the spigot part and the bell part.

Next, this invention will be explained in more detail based on the drawings.

Fig. 4 is a drawing for explaining the constitution of this invention. The symbols 1–3, 5, and 6 have the same meanings as in Figs. 1–3. 7 is the gap between the bell and spigot parts and 8 is a dam made from adhesive tape, etc., on the bell opening. In the method of this invention, first, the spigot part of one pipe unit is inserted into the bell part of the other pipe unit; after this, an inner laminating part 6 consisting of FRP is placed on the inner surface of the pipe joint part, so that it covers the contacting parts of the end 5 of the spigot part and the bottom part 1' of the bell. This inner laminating part 6 is made by laminating ordinarily about 3 layers of a string-shaped glass fiber woven fabric impregnated with an adhesive made of the same unsaturated polyester resin or epoxy resin as that used when the pipe unit is made, adhering them to the inner surface of the joint part of the tube and then hardening them. Next, a low-viscosity adhesive, of 0.3–20 poise is injected into the gap 7 between the bell 1 and spigot 3 parts. In this invention, since this low-viscosity adhesive is used, the adhesive can be smoothly injected into the gap between the spigot and bell parts and the adhesive flows downward from the place where it is injected due to gravity, first reaching part of the lower end 5 of the spigot and then gradually filling the gap 7 upwards from the lower part of the gap, expelling the air. Therefore, not only can the gap be filled completely with the adhesive, but since the gap can be very arrow, 1–2 mm, as mentioned above, only a small quantity of adhesive is needed, and a strong adhesive force is obtained. The adhesive used consists of the same unsaturated resin that was used in making the pipe units; for example, when the pipe is made of a

polyester resin, it is desirable to use an unsaturated polyester resin or epoxy resin adhesive.

In order to increase the adhesiveness of the bell and spigot parts or the adhesiveness of the inner laminating part 6 and the tube part, it is desirable to roughen the outer surface of the spigot, the inner surface of the bell, the inner surface of the spigot, and the lower inner surface of the bell by sanding or blasting before the spigot part is inserted into the bell part.

Working Example

After the inner surface of the bell part and the lower inner surface of the bell part of a glass-fiber-reinforced polyester resin pipe unit 550 cm in diameter, 2.7 cm thick, and 10 m long, with a bell part 15 cm long, were sand-blasted, the spigot part of the pipe unit, with the outer and inner surfaces sandblasted, was inserted into the bell part. The gap between the bell and spigot parts was 3–5 mm. Next, 3 layers of a string-shaped glass fiber fabric 15–50 cm wide with an unsaturated polyester adhesive (trade name "Derakein 470-36," Dow Chemical Japan Co.) impregnated into it were laminated on the inner surface of the contact parts of the pipes in such a way that the lower end 5 of the spigot and the bottom surface of the bell were covered, forming the inner laminating part 6, and to make injection of the adhesive easier, a dam 8 was formed on the bell opening with adhesive tape. Next, an unsaturated polyester adhesive (trade name "Derakein 470-36," Dow Chemical Japan Co.) with a viscosity of 2.0 poise was injected at 1 kg/minute. After approximately 10 minutes, the gap between the bell and spigot parts was filled by the adhesive. After this, the adhesive was hardened by leaving it at room temperature.

Effectiveness of the Invention

In this invention, since an adhesive can be completely injected into the gap in which the adhesive is applied, the spigot and bell parts can be more completely adhered, compared with the conventional method, and the gap between the spigot and bell parts can be made small. Therefore, the quantity of adhesive used can be reduced, and the workability can be improved by 1/2–1/3 over the conventional method.

4. Simple Explanation of Drawings

Figs. 1–3 are cross-sectional drawings of two tube bodies for explaining the conventional method of joining chimney lining tubes. Fig. 4 is a cross-sectional drawing for explaining the method of this invention.

1 ... bell part, 2 ... tube unit, 3 ... spigot part, 4 ... adhesive, 5 ... lower end surface of the spigot part, 6 ... inner surface laminating part, 7 ... gap between the bell and spigot parts, 8 ... dam

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Fig. 1

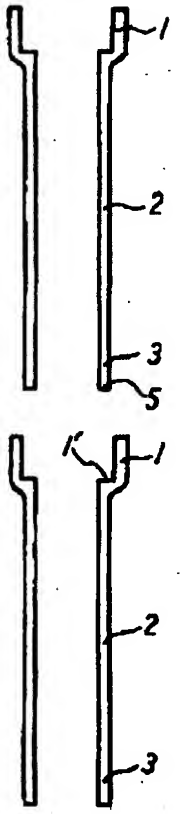

Fig. 2

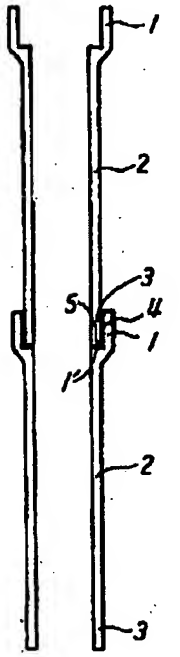

Fig. 3

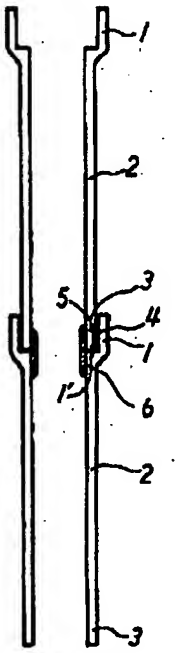

Fig. 4